Environmental Assessment of Industrial Tailing Migration and Reclamation Tactics, Cobalt, Ontario

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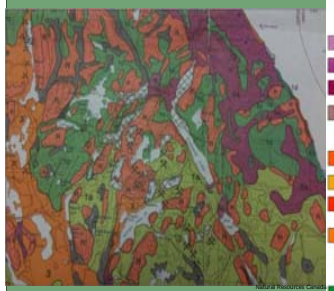
Objective

Starting in 1904 through the mid 1930's, Cobalt's mines and mills operated continuously. From then until 1989, operations were intermittent. Mining practices predating the 1930's left significant pollution. Evident as; historic remnant mine workings, waste rock piles, and tailings ponds. Within the Cobalt mining camp, we must familiarize ourselves with the geomorphic setting to proper facilitate the rehabilitation of the tailings as well as the environment. Cobalt's mining legacy has taught us how arsenic has poisoned the landscape, but what is there to learn from this, and how can we revitalize Ontario's most historic City.

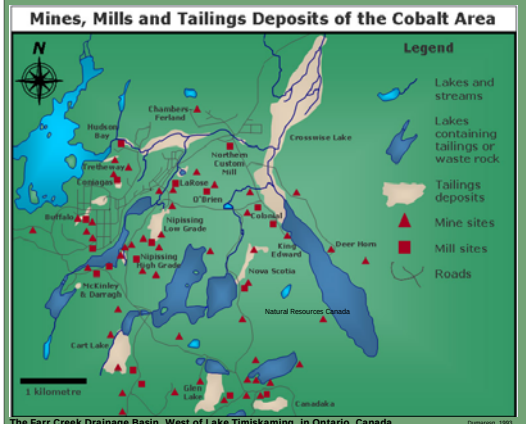
Geology

- Ores occur predominately in veins of a complex assemblage of minerals
- Native silver, cobalt, and nickelarsenides, sulphides, sulpharsenides, sulpharsenites, antimonides, sulphantimonides, sulfbismuthinites
- Secondary alteration products also present
- Gangue is predominately carbonate
- The most significant impurities are antimony, arsenic and mercury.



- Coleman member of the Gowganda Formation; conglomerates, greywacke, quartzite and arkose
- The Coleman Member is overlain by Pre-Cambrian Lorrain Formation
- All units cut by early Proterozoic Nipissing diabase
- Ag-Co-Ni-As deposits spatially associated with the diabase
- Lake Timiskaming to the east is centered on top of ancient St. Lawrence Rift
- Timiskaming Graben entrenches Cobalt from the west
- Apart of Northern extension Ottowa-Bonnechere Graben

The Study Area



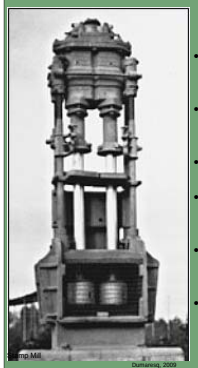
The Farr Creek Drainage Basin. West of Lake Timiskaming, in Ontario, Canada

Dumaresq, 1993

Mining Practices

The complexity and unique character of Cobalt's silver ore presented problems for metallurgists

- Hand sorting occurred from the years 1904-1906
- 1907 Stamp Mills were introduced to Cobalt
- Post pulverization, gravity concentration was used to separate ores



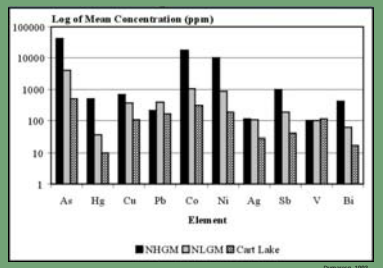
Stamp Mill

Dumaresq, 2009

- Concentrates from gravity concentration were processed
- The waste product formed is known as tailings
- In 1909, cyanidation was brought to Cobalt
- In the cyanide process ground ore was mixed with potassium cyanide dissolving the silver
- Powdered aluminum was then added, causing the silver to precipitate
- During World War I, many mills switched to If flotation separation

- In 1911, the Nipissing high grade mill (NHGM) was brought into operation.
- In this mill high grade ore was ground in mercury and potassium cyanide
- The tailings from high grade mills like the Nipissing mill contain mercury, arsenic, nickel and cobalt

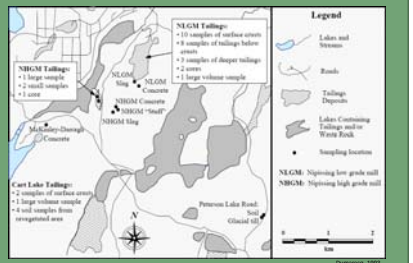
Results



Dumaresq, 1993

Arsenic (III) generally accounts for less than 15% of the total arsenic in surface waters, with the remainder of the arsenic occurring as arsenic (V). In contrast, the ground water samples of the Farr Creek Basin area contained up to 77% of the total as arsenic (III)

BacTech, 2009



Dumaresq, 1993

Distribution of tailings in the Cobalt area and the four vegetation study sites: (F) forest,(M) meadow, (T) tailings,(W) wetland.

Dumaresq, 2009

Reclamation

- Natural re-vegetation occurs on some areas where tailings exist.
- Re-vegetation from anthropogenic and plant sources has occurred "on accident", but discovered a positive player in site remediation
- Bioleaching is an eco-friendly technology for the mining area remediation process drainage (BacTech,2009)

Dumaresq, 2009

Nipissing Low Grade Mill

Dumaresq, 2009

Comparison of a photo taken shortly after the mill burned down

Dumaresq, 2009

As much as 50 % of the tailings present in 1934 have been eroded

Summary

Very limited mitigation has occurred since mining stopped. With this, contamination of the surface drainage system from leaching of the widespread mine waste continues. Both cobalt, and nickel correlate with arsenic in surface waters, suggesting that the possible source for metals is more than likely ephemeral secondary minerals produced by the weathering of arsenides, sulpharsenides, cobalt and nickel.

Future Study

Future monitoring in the area should include continued sampling of water draining these tailings, to determine current arsenic concentrations. Photographs correlating to each area(s) should be taken on a yearly basis for comparison on site-specific re-vegetation efforts.

References

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- Charles Dumaresq, The Occurrence of Arsenic and Heavy Metal Contamination from Natural and Anthropogenic Sources in the Cobalt Area of Ontario. Masters Thesis prepared by Charles Dumaresq, Carleton University. 1993.
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Acknowledgments

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